Japanese Publication No. H11-136187

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] In the failure remedy of a wave-length-multiple-telecommunication system which changes two or more signals into the lightwave signal with which wavelength differs, respectively, multiplexs between transmission equipment, and performs wavelength multiplex optical telecommunications The function which transmits and receives reserve wavelength other than the wavelength used for a communication link is given to each transmission equipment. Failure remedy of the wave-length-multiple-telecommunication system characterized by transmitting this information to transmitting-side transmission equipment, changing into the lightwave signal of said reserve wavelength the signal which the failure generated in transmitting-side transmission equipment, and transmitting when a failure is detected by reception of which lightwave signal with receiving-side transmission equipment.
[Claim 2] In the failure remedy of a wave-length-multiple-telecommunication system which changes two or more signals into the lightwave signal with which wavelength differs, respectively, multiplexs between transmission equipment, and performs wavelength multiplex optical telecommunications The function which transmits and receives two or more reserve wavelength other than the wavelength used for a communication link is given to each transmission equipment. When a failure is detected by reception of any or two or more lightwave signals with receiving-side transmission equipment, Failure remedy of the wave-length-multiple-telecommunication system characterized by transmitting this information to transmitting-side transmission equipment, changing into the lightwave signal of two or more of said reserve wavelength two or more signals which the failure generated in transmitting-side transmission equipment, respectively, and transmitting.
[Claim 3] The optical transmitting section which changes two or more signals, multiplexs them to each transmission equipment at the lightwave signal with which wavelength differs, respectively, and transmits a wavelength multiplexing lightwave signal to a transmission line, The optical receive section which separates spectrally the wavelength multiplexing lightwave signal received from the transmission line, and the optical transmitting section of the same reserve as said optical transmitting section and an optical receive section and a spare optical receive section are prepared. In the failure remedy of the wave-length-multiple-telecommunication system to which said optical transmitting section and said optical receive section were connected to in the transmission line between each transmission equipment, and the optical transmitting section of said reserve and the optical receive section of said reserve were

connected in the spare transmission line The function which transmits and receives two or more reserve wavelength other than the wavelength used for a communication link at said optical transmitting section, The function to receive said two or more reserve wavelength is given to said optical receive section. When a failure is detected by reception of any or two or more lightwave signals in the optical receive section of receiving-side transmission equipment, Failure remedy of the wave-length-multiple-telecommunication system characterized by transmitting this information to the optical transmitting section of transmitting-side transmission equipment, changing into the lightwave signal of two or more of said reserve wavelength the signal which the failure generated in this optical transmitting section, and transmitting.

[Claim 4] In the wave-length-multiple-telecommunication system which performs wavelength multiplex optical telecommunications between transmission equipment The optical transmitting section which changes two or more signals, multiplexs them to each transmission equipment at the lightwave signal with which wavelength differs, respectively, and transmits a wavelength multiplexing lightwave signal to a transmission line, The reserve wavelength transmitting section it changes [section] into reserve wavelength other than the wavelength which changes into said lightwave signal any of two or more of said signals they are, and multiplexs [section] to said wavelength multiplexing lightwave signal, With the optical receive section which separates spectrally and outputs the received wavelength multiplexing lightwave signal from a transmission line When it is detected that the failure occurred in the supervisory circuit which detects the lightwave signal which supervised each lightwave signal separated spectrally and the failure generated, and which lightwave signal, while choosing the lightwave signal of said reserve wavelength as an output of this lightwave signal The wave-length-multiple-telecommunication system characterized by having the control means which transmits the information on the lightwave signal which the failure generated to transmitting-side transmission equipment, and the means for switching which transforms the signal which said reserve wavelength transmitting section is operated and corresponds using said information transmitted from receiving-side transmission equipment to said reserve wavelength.

[Claim 5] In the wave-length-multiple-telecommunication system which performs wavelength multiplex optical telecommunications between transmission equipment The optical transmitting section which changes two or more signals, multiplexs them to each transmission equipment at the lightwave signal with which wavelength differs, respectively, and transmits a wavelength multiplexing lightwave signal to a transmission line, The reserve wavelength transmitting section it changes [section] into two or more reserve wavelength other than the wavelength which changes any of two or more of said signals, or plurality into said lightwave signal, respectively, and multiplexs [section] to said wavelength multiplexing lightwave signal, With the optical receive section which separates spectrally and outputs the received wavelength multiplexing lightwave signal from a transmission line When it is detected that the failure occurred in the supervisory circuit which detects the lightwave signal which supervised each lightwave signal separated spectrally and the failure generated, and any or two or more lightwave signals, while choosing the lightwave signal of said reserve wavelength as an output of two or more of these lightwave signals, respectively Using the control means which transmits the information on the lightwave signal which the failure generated to transmitting-side transmission equipment, and said information transmitted from receiving-side transmission equipment The wave-length-multiple-telecommunication system characterized by having the means for switching which transforms two or more signals which said reserve wavelength transmitting section is operated and correspond to said two or more reserve wavelength, respectively.

[Claim 6] The wave-length-multiple-telecommunication system according to claim 4 to 5 characterized by the optical transmitting section of said reserve and the optical receive section of said reserve having further the spare transceiver system connected in the spare transmission line while having the still more nearly same spare optical transmitting section as said optical transmitting section, and the optical receive section of the same reserve as said optical receive section in each transmission equipment.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention changes two or more signals into the light from which wavelength differs, respectively, multiplexs, and relates to failure relief of the wave-length-multiple-telecommunication system which performs wave-length multiple telecommunication through a transmission line and its failure remedy, especially the optical output circuit of transmission equipment.
[0002]
[Description of the Prior Art] Drawing 2 is the functional block diagram showing an example of this conventional kind of wave-length-multiple-telecommunication system. In drawing 2 , 100 and 200 are transmission equipment, respectively, optical transmitting section 101a and optical receive section 101b are prepared in transmission equipment 100, optical receive section 201a and optical transmitting section 201b are prepared in transmission equipment 200, and two-way communication is performed through two transmission lines 8a and 8b.
[0003] Moreover, the optical output circuit which changes the electrical signal into which 2 is inputted, respectively into the lightwave signal of the wavelength (lambda1-lambda4) which was able to be defined beforehand, respectively, The multiplexing machine which 3 multiplexs the lightwave signal from each optical output circuit 2, and is made into one wavelength multiplexing lightwave signal, The transmitting-side amplifier which amplifies the lightwave signal with which 4 was multiplexed, the receiving-side optical amplifier which amplifies the lightwave signal with which 5 has been sent through a transmission line, The splitter with which 6 separates a lightwave signal spectrally, and 7 are band pass filters (BPF) with which passage frequency bands differ, respectively, and it is changed into an electrical signal by the light /

electric transducer which the lightwave signal which the lightwave signal of each wavelength was separated and was separated by the splitter 6 and BPF7 does not illustrate.
[0004] Next, actuation is explained. Four lightwave signals which were changed into four lightwave signals of the wavelength (drawing 2 lambda1-lambda4) defined beforehand in the optical output circuit 2, respectively, and were changed into each wavelength lambda1-lambda4 are multiplexed with the multiplexing vessel 3, and by the transmitting-side amplifier 4, each signal (drawing 2 four signals) inputted from the outside amplifies optical output power, and is sent out to transmission-line 8a. Moreover, in a receiving side, after amplifying the optical-multiplexing signal decreased through transmission-line 8a with the receiving-side amplifier 5, wavelength separation of lambda1-lambda4 is performed, each lightwave signal is changed into an electrical signal, and reception of a signal is performed by a splitter 6 and BPF7. Moreover, the communication link to transmission equipment 100 from transmission equipment 200 is performed similarly.
[0005] When a failure occurs, for example in the optical output circuit of lambda 1, it becomes impossible however, to transmit one of four signals which should be transmitted in a wave-length-multiple-telecommunication system as shown in drawing 2 . Therefore, as shown in drawing 3 , while giving the spare optical transmitting sections 102a and 202b and the spare optical receive sections 102b and 202a to each transmission equipment in this kind of wave-length-multiple-telecommunication system, respectively When it has spare transmission-line 8-2a and 8-2b, for example, a failure occurs in the optical output circuit of lambda 1, hand control or the change-over circuit which is not illustrated operates, and it is constituted so that it may communicate by switching to spare optical transmitting section 102a, transmission-line 8-2a, and spare optical receive section 202a.
[0006]
[Problem(s) to be Solved by the Invention] Since the conventional wave-length-multiple-telecommunication system has the composition of it having been constituted as mentioned above and having given the spare transceiver system in preparation for generating of a failure, respectively, it becomes expensive, while a system is complicated and enlarging. Moreover, although a line failure may be caused when the further failure occurs in the transceiver system of this reserve since it is applied only by the spare transceiver system until it makes package exchange etc. restore when a failure occurs Since the wavelength to be used was specified, the optical output circuit of a wave-length-multiple-telecommunication system had troubles, like the case where the optical output circuit which had to give the package of each wavelength to maintenance, for this reason the failure generated is unexchangeable immediately arises.
[0007] When this invention is made in order to solve this trouble, and it does not need a spare transceiver system but a failure occurs in an optical output circuit, it aims at offering the wave-length-multiple-telecommunication system which switches an optical output circuit for transmission equipment itself, and can continue a communication link, and its failure remedy.
[0008]
[Means for Solving the Problem] The failure remedy of the wave-length-multiple-telecommunication system concerning this invention In the failure remedy of a wave-length-multiple-telecommunication system which changes two or more signals into the lightwave signal with which wavelength differs, respectively, multiplexs between transmission equipment, and performs wavelength multiplex optical telecommunications The function which transmits and receives reserve wavelength other than the wavelength used for a communication link is given to each transmission equipment. When a failure is detected by reception of which lightwave signal

with receiving-side transmission equipment, it is characterized by transmitting this information to transmitting-side transmission equipment, changing into the lightwave signal of said reserve wavelength the signal which the failure generated in transmitting-side transmission equipment, and transmitting.
[0009] Moreover, when the function which transmits and receives two or more reserve wavelength other than the wavelength used for a communication link is given to each transmission equipment and a failure is detected by reception of any or two or more lightwave signals with receiving-side transmission equipment, it is characterized by transmitting this information to transmitting-side transmission equipment, changing into the lightwave signal of two or more of said reserve wavelength two or more signals which the failure generated in transmitting-side transmission equipment, respectively, and transmitting.
[0010] The optical transmitting section which changes two or more signals, multiplexs them to each transmission equipment at the lightwave signal with which wavelength differs, respectively, and furthermore transmits a wavelength multiplexing lightwave signal to a transmission line, The optical receive section which separates spectrally the wavelength multiplexing lightwave signal received from the transmission line, and the optical transmitting section of the same reserve as said optical transmitting section and an optical receive section and a spare optical receive section are prepared. In the failure remedy of the wave-length-multiple-telecommunication system to which said optical transmitting section and said optical receive section were connected to in the transmission line between each transmission equipment, and the optical transmitting section of said reserve and the optical receive section of said reserve were connected in the spare transmission line The function which transmits and receives two or more reserve wavelength other than the wavelength used for a communication link at said optical transmitting section, The function to receive said two or more reserve wavelength is given to said optical receive section. When a failure is detected by reception of any or two or more lightwave signals in the optical receive section of receiving-side transmission equipment, it is characterized by transmitting this information to the optical transmitting section of transmitting-side transmission equipment, changing into the lightwave signal of two or more of said reserve wavelength the signal which the failure generated in this optical transmitting section, and transmitting.
[0011] Moreover, the wave-length-multiple-telecommunication system concerning this invention In the wave-length-multiple-telecommunication system which performs wavelength multiplex optical telecommunications between transmission equipment The optical transmitting section which changes two or more signals, multiplexs them to each transmission equipment at the lightwave signal with which wavelength differs, respectively, and transmits a wavelength multiplexing lightwave signal to a transmission line, The reserve wavelength transmitting section it changes [section] into reserve wavelength other than the wavelength which changes into said lightwave signal any of two or more of said signals they are, and multiplexs [section] to said wavelength multiplexing lightwave signal, With the optical receive section which separates spectrally and outputs the received wavelength multiplexing lightwave signal from a transmission line When it is detected that the failure occurred in the supervisory circuit which detects the lightwave signal which supervised each lightwave signal separated spectrally and the failure generated, and which lightwave signal, while choosing the lightwave signal of said reserve wavelength as an output of this lightwave signal It is characterized by having the control means which transmits the information on the lightwave signal which the failure generated to transmitting-side transmission equipment, and the means for switching which transforms the

signal which said reserve wavelength transmitting section is operated and corresponds using said information transmitted from receiving-side transmission equipment to said reserve wavelength.
[0012] Moreover, the optical transmitting section which changes two or more signals, multiplexs them to each transmission equipment at the lightwave signal with which wavelength differs, respectively, and transmits a wavelength multiplexing lightwave signal to a transmission line, The reserve wavelength transmitting section it changes [section] into two or more reserve wavelength other than the wavelength which changes any of two or more of said signals, or plurality into said lightwave signal, respectively, and multiplexs [section] to said wavelength multiplexing lightwave signal, With the optical receive section which separates spectrally and outputs the received wavelength multiplexing lightwave signal from a transmission line When it is detected that the failure occurred in the supervisory circuit which detects the lightwave signal which supervised each lightwave signal separated spectrally and the failure generated, and any or two or more lightwave signals, while choosing the lightwave signal of said reserve wavelength as an output of two or more of these lightwave signals, respectively It is characterized by having the control means which transmits the information on the lightwave signal which the failure generated to transmitting-side transmission equipment, and the means for switching which transforms two or more signals which said reserve wavelength transmitting section is operated and correspond using said information transmitted from receiving-side transmission equipment to said two or more reserve wavelength, respectively.
[0013] Furthermore, while having the still more nearly same spare optical transmitting section as said optical transmitting section, and the optical receive section of the same reserve as said optical receive section in each transmission equipment, the optical transmitting section of said reserve and the optical receive section of said reserve are characterized by having further the spare transceiver system connected in the spare transmission line.
[0014] Since the system itself switches to reserve wavelength and it continues a communication link to the failure of an optical output circuit by considering as the above configurations, it becomes unnecessary to equip the wave-length-multiple-telecommunication system and its failure remedy of this invention with a spare transceiver system.
[0015]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing. Drawing 1 is the block diagram showing 1 operation gestalt of this invention, and transmission equipment, and 8a and 8b of 100 and 200 are transmission lines in drawing 1 , respectively. Moreover, the optical output circuit which changes the electrical signal into which 2 is inputted, respectively into the lightwave signal of the wavelength (lambda1-lambda4) which was able to be defined beforehand, respectively in each transmission equipment, The multiplexing machine which 3 multiplexs the lightwave signal from each optical output circuit 2, and is made into one wavelength multiplexing lightwave signal, The transmitting-side amplifier which amplifies the lightwave signal with which 4 was multiplexed, the receiving-side optical amplifier which amplifies the lightwave signal with which 5 has been sent through a transmission line, The splitter with which 6 separates a lightwave signal spectrally, and 7 are band pass filters (BPF) with which passage frequency bands differ, respectively. It is that these are the same as that of the same sign of drawing 2 , or a corresponding part, and the optical transmitting sections 101a and 201b and the optical receive sections 101b and 201a are formed by these like drawing 2 , respectively.
[0016] Moreover, a coupler for a band pass filter (BPF) for the supervisory circuit where 10 supervises the condition (that is, is the normal lightwave signal transmitted or not?) of the

lightwave signal of each wavelength, and 20 to extract the reserve wavelength lambda 5, and 30 to carry out optical branching of the optical output from BPF20 at the number of sending signals, and 40 are the selection circuitries for switching and outputting the lightwave signal from BPF7, or the lightwave signal from a coupler 30. Moreover, 50 outputs the control information which is a control circuit, and tells a transmitting side about to which light wave length signal abnormalities have occurred while operating the selection circuitry 40 to the wavelength on which abnormalities were detected and making the lightwave signal from a coupler 30 choose, when abnormalities are detected by which light wave length signal in a supervisory circuit 10.
[0017] A splitter for a multiplexing machine for the electrical and electric equipment / optical transducer for 60 to change the control information from a control circuit 50 into a lightwave signal, and 61 to multiplex to the wavelength multiplexing lightwave signal which uses this lightwave signal for a communication link, and 62 to extract the lightwave signal which shows control information from the wavelength multiplexing lightwave signal sent from the transmitting side, and 63 are the light / electric transducer for changing the lightwave signal of a splitter 62 into an electrical signal, and outputting control information. Moreover, the selection circuitry which chooses one in a coupler for 70 to branch the electrical signal inputted from the outside and two or more electrical signals into which 80 is inputted according to the control information from the receiving-side control circuit 50, and 90 are the optical output circuits for changing the electrical signal chosen by the selection circuitry 80 into the wavelength lambda1, lambda2, and lambda3 currently used by the normal communication link, and reserve wavelength lambda 5 other than lambda4.
[0018] In addition, the control means which says an optical output circuit also as the reserve wavelength transmitting section, and is said on these specifications with a coupler 30, a selection circuitry 40, a control circuit 50, the electrical and electric equipment / optical transducer 60, and the multiplexing vessel 61 is constituted, and the means for switching further said on these specifications by the splitter 62, light / electric transducer 63, the coupler 70, and the selection circuitry 80 consists of these specifications.
[0019] Next, actuation of the operation gestalt shown in drawing 1 is explained. For example, in the receiving side of transmission equipment 200, the wavelength multiplexing lightwave signal received is divided into each lightwave signal by the splitter 6 and BPF7, each lightwave signal is outputted to a selection circuitry 40 and a supervisory circuit 10, and a supervisory circuit 10 supervises each lightwave signal. When the control circuit 50 was collecting the monitor results of a supervisory circuit 10 and abnormalities are detected by which lightwave signal in a supervisory circuit 10, To which light wave length signal abnormalities occurred And when abnormalities are detected by which lightwave signal in a supervisory circuit 10, The control information which tells a transmitting side about to which light wave length signal abnormalities have occurred is generated, and it multiplexs to the wavelength multiplexing lightwave signal which changes this control information into delivery and a lightwave signal to the electrical and electric equipment / optical transducer 60, and is used for a communication link with the multiplexing vessel 61. And the wavelength multiplexing lightwave signal with which it was multiplexed in control information is transmitted to the optical receive section of transmission equipment 100 through transmission-line 8b.
[0020] In transmission equipment 100, the lightwave signal on which control information has ridden with the splitter 62 is extracted from the wavelength multiplexing lightwave signal inputted through transmission-line 8b, and it changes into an electrical signal by light / electric transducer 63, and inputs into a selection circuitry 80. Each sending signal from the outside

which branched with the coupler 70 is inputted into the selection circuitry 80 as mentioned above, and a selection circuitry 80 inputs the sending signal which receiving abnormalities have generated according to the sent control information into the spare optical output circuit 90, changes this sending signal into the lightwave signal of the reserve wavelength lambda 5, multiplexs to the wavelength multiplexing lightwave signal transmitted with the multiplexing vessel 3, and transmits to transmission equipment 200 through transmission-line 8a.
[0021] Although the wavelength multiplexing lightwave signal transmitted to transmission equipment 200 is divided into each lightwave signal by a splitter 6 and each BPF, BPF20 is set up so that the lightwave signal of wavelength lambda 5 may be outputted, and the lightwave signal of the outputted wavelength lambda 5 is inputted into a selection circuitry 40 through a coupler 30. By the surveillance intelligence from a supervisory circuit 10, the control circuit 50 has switched the input of the selection circuitry 40 of the lightwave signal with which abnormalities were detected to the input from the coupler 30, and the lightwave signal with which abnormalities were detected by this communicates on the reserve wavelength lambda 5, and can continue now the communication link of a wavelength multiplexing lightwave signal.
[0022] In addition, although wavelength used for a signal is set to lambda1-lambda4 and reserve wavelength is explained as lambda 5 with the operation gestalt shown in drawing 1 , it is good also as a configuration which the wavelength used for a signal is not necessarily limited to four waves, and gave two or more waves of reserve wavelength. Moreover, with the operation gestalt shown in drawing 1 , although it can be made to correspond to the failure of the optical output circuit 2, it cannot respond to the failure of a transmission line. Therefore, it can also consider as the configuration which gave the optical transmitting section of a reserve as further shown in drawing 3 , the spare optical receive section, and the transceiver system of the reserve which consists of a spare transmission line.
[0023]
[Effect of the Invention] As explained above, the restoration of a failure of them is attained without affecting an end user until it switches automatically the wave-length-multiple-telecommunication system and its failure remedy of this invention to reserve wavelength by the wavelength multiplexer side, and they can continue a communication link, even if a failure occurs on which wavelength, and they are exchanged in the package of failure wavelength. Moreover, since a communication link is continuable on reserve wavelength, there is effectiveness -- it becomes unnecessary to necessarily carry out the reserve of the optical output circuit of full wave length to transmission equipment etc..

[Translation done.]

Reference 4'

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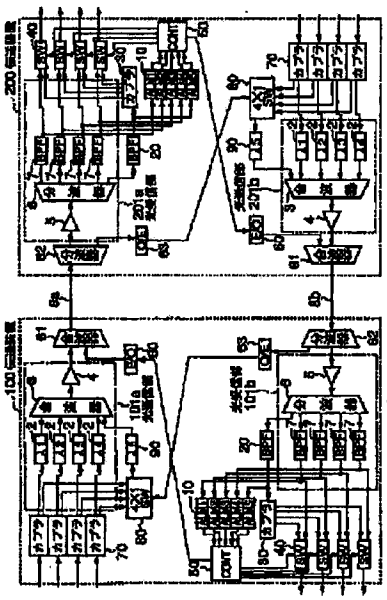
(54) WAVELENGTH MULTIPLEX COMMUNICATION SYSTEM AND ITS FAULT RELIEF METHOD

(57) Abstract:

PROBLEM TO BE SOLVED: To provide a wavelength multiplex communication system and its fault relief method where an optical output circuit is selected by a transmitter itself to continue communication on the occurrence of a fault in the optical output circuit, without the need for a standby transmission/reception system.

SOLUTION: Each of transmitters 100, 200 has a function 90 of sending/ receiving a standby wavelength λ5 other than wavelength bands λ1-λ5 used for communication, and in the case that a fault is detected in the reception of any optical signal by a monitor circuit 10 of a receiver side transmitter, the information is sent to transmitter side devices 50, 60, 61, 8b, 62, 63 and the transmitter side devices 70, 80, 90 convert a signal with a fault into an optical signal with a standby quantity λ5 and transmit the converted signal.



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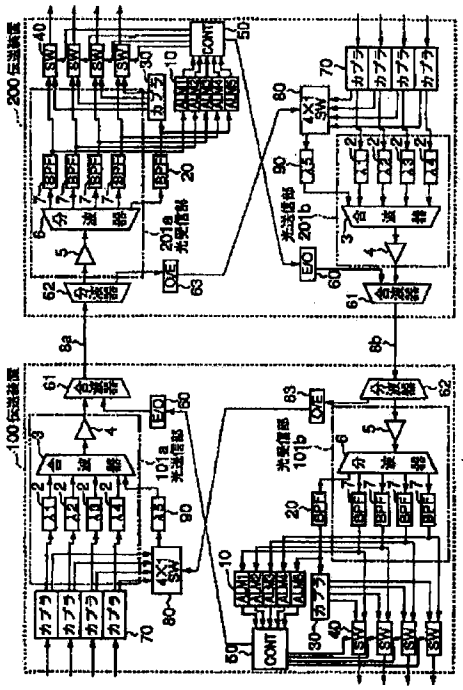
(54)【発明の名称】　波長多重通信システム及びその障害救済方法

(57)【要約】

【課題】　従来のこの種の波長多重通信システムでは、光出力回路障害で１波長の信号がダウンした場合でも予備の送受信系を用いて通信しなければならない。

【解決手段】　各伝送装置１００，２００に、通信に用いる波長λ１～λ４以外の予備波長λ５を送受信する機能９０を持たせておき、受信側伝送装置の監視回路１０でで何れかの光信号の受信に障害が検出される場合、この情報を５０，６０，６１，８ｂ，６２，６３送信側伝送装置へ送信し、送信側伝送装置では障害が発生した信号を７０，８０，９０で予備波長λ５の光信号に変換して送信する。



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【特許請求の範囲】

【請求項１】　伝送装置間で複数の信号をそれぞれ波長の異なる光信号に変換して合波し波長多重光通信を行う波長多重通信システムの障害救済方法において、

各伝送装置に、通信に用いる波長以外の予備波長を送受信する機能を持たせておき、受信側伝送装置で何れかの光信号の受信に障害が検出される場合、この情報を送信側伝送装置へ送信し、送信側伝送装置では障害が発生した信号を前記予備波長の光信号に変換して送信することを特徴とする波長多重通信システムの障害救済方法。

【請求項２】　伝送装置間で複数の信号をそれぞれ波長の異なる光信号に変換して合波し波長多重光通信を行う波長多重通信システムの障害救済方法において、

各伝送装置に、通信に用いる波長以外の複数の予備波長を送受信する機能を持たせておき、受信側伝送装置で何れか複数の光信号の受信に障害が検出される場合、この情報を送信側伝送装置へ送信し、送信側伝送装置では障害が発生した複数の信号を前記複数の予備波長の光信号にそれぞれ変換して送信することを特徴とする波長多重通信システムの障害救済方法。

【請求項３】　各伝送装置に、複数の信号をそれぞれ波長の異なる光信号に変換して合波し伝送路へ波長多重光信号を送信する光送信部と、伝送路から受信された波長多重光信号を分波する光受信部と、前記光送信部及び光受信部と同じ予備の光送信部及び予備の光受信部とが設けられ、

各伝送装置間で前記光送信部と前記光受信部とが伝送路で接続され、前記予備の光送信部と前記予備の光受信部とが予備の伝送路で接続された波長多重通信システムの障害救済方法において、

前記光送信部に通信に用いる波長以外の複数の予備波長を送受信する機能と、前記光受信部に前記複数の予備波長を受信する機能とを持たせておき、

受信側伝送装置の光受信部で何れか複数の光信号の受信に障害が検出される場合、この情報を送信側伝送装置の光送信部へ送信し、該光送信部では障害が発生した信号を前記複数の予備波長の光信号に変換して送信することを特徴とする波長多重通信システムの障害救済方法。

【請求項４】　伝送装置間で波長多重光通信を行う波長多重通信システムにおいて、

各伝送装置に、

複数の信号をそれぞれ波長の異なる光信号に変換して合波し伝送路へ波長多重光信号を送信する光送信部と、前記複数の信号の何れかを前記光信号に変換する波長以外の予備波長に変換し前記波長多重光信号に合波する予備波長送信部と、伝送路から受信された波長多重光信号を分波し出力する光受信部と、分波された各光信号を監視して障害が発生した光信号を検出する監視回路と、何れかの光信号に障害が発生したことを検出した場合、該光信号の出力として前記予備波長の光信号を選択すると共に、障害が発生した光信号の情報を送信側伝送装置に送信する制御手段と、受信側伝送装置から送信された前記情報により、前記予備波長送信部を動作させて該当する信号を前記予備波長に変換させる切換手段とを備えたことを特徴とする波長多重通信システム。

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【請求項５】　伝送装置間で波長多重光通信を行う波長多重通信システムにおいて、

各伝送装置に、

複数の信号をそれぞれ波長の異なる光信号に変換して合波し伝送路へ波長多重光信号を送信する光送信部と、前記複数の信号の何れか複数をそれぞれ前記光信号に変換する波長以外の複数の予備波長に変換し前記波長多重光信号に合波する予備波長送信部と、伝送路から受信された波長多重光信号を分波し出力する光受信部と、分波された各光信号を監視して障害が発生した光信号を検出する監視回路と、何れか複数の光信号に障害が発生したことを検出した場合、該複数の光信号の出力としてそれぞれ前記予備波長の光信号を選択すると共に、障害が発生した光信号の情報を送信側伝送装置に送信する制御手段と、受信側伝送装置から送信された前記情報により、前記予備波長送信部を動作させて該当する複数の信号をそれぞれ前記複数の予備波長に変換させる切換手段とを備えたことを特徴とする波長多重通信システム。

【請求項６】　各伝送装置にさらに、前記光送信部と同じ予備の光送信部と、前記光受信部と同じ予備の光受信部とを有すると共に、前記予備の光送信部と前記予備の光受信部とが予備の伝送路で接続された、予備の送受信系をさらに備えたことを特徴とする請求項４乃至請求項５記載の波長多重通信システム。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は複数の信号をそれぞれ波長の異なる光に変換して合波し、伝送路を介して波長多重通信を行う波長多重通信システム及びその障害救済方法、特に伝送装置の光出力回路の障害救済に関する。

【０００２】

【従来の技術】図２は、従来のこの種の波長多重通信システムの一例を示す機能ブロック図である。図２において、１００及び２００はそれぞれ伝送装置であり、伝送装置１００には光送信部１０１ａ及び光受信部１０１ｂが設けられ、伝送装置２００には光受信部２０１ａと光送信部２０１ｂが設けられ、２本の伝送路８ａ，８ｂを介して双方向通信が行われる。

【０００３】また、２はそれぞれ入力される電気信号をそれぞれ予め定められた波長（λ１～λ４）の光信号に変換する光出力回路、３は各光出力回路２からの光信号を合波して１本の波長多重光信号とする合波器、４は多重化された光信号を増幅する送信側増幅器、５は伝送路を介して送られてきた光信号を増幅する受信側光増幅

器、６は光信号を分波する分波器、７はそれぞれ通過周波数帯域の異なるバンドパスフィルタ（ＢＰＦ）であり、分波器６及びＢＰＦ７で各波長の光信号が分離され、分離された光信号が図示しない光／電気変換部によって電気信号に変換される。

【０００４】次に動作について説明する。外部から入力される各信号（図２では４本の信号）は、光出力回路２でそれぞれ予め定められた波長（図２ではλ１～λ４）の４つの光信号に変換され、各波長λ１～λ４に変換された４つの光信号が合波器３によって多重化され、送信側増幅器４によって光出力パワーを増幅して伝送路８ａへ送出される。また、受信側では伝送路８ａを通って減衰した光多重化信号を受信側増幅器５で増幅した後、分波器６及びＢＰＦ７によって、λ１～λ４の波長分離を行い、それぞれの光信号を電気信号に変換して信号の受信が行われる。また伝送装置２００から伝送装置１００への通信も同様にして行われる。

【０００５】然しながら図２に示すような波長多重通信システムでは、例えばλ１の光出力回路に障害が発生した場合、送信すべき４つの信号のうちの１信号が送信できなくなる。従ってこの種の波長多重通信システムでは、図３に示すように各伝送装置にそれぞれ予備の光送信部１０２ａ，２０２ｂと、予備の光受信部１０２ｂ，２０２ａを持たせると共に、予備の伝送路８－２ａ，８－２ｂを備えておき、例えばλ１の光出力回路に障害が発生した場合、手動あるいは図示しない切換回路が動作して、予備の光送信部１０２ａ，伝送路８－２ａ，予備の光受信部２０２ａに切り換えて通信を行うように構成されている。

【０００６】

【発明が解決しようとする課題】従来の波長多重通信システムは以上のように構成され、障害の発生に備えて予備の送受信系をそれぞれ持たせた構成となっているので、システムが複雑で大型化すると共に高価になる。また障害が発生した場合、パッケージ交換等によって復旧させるまで、予備の送受信系だけで運用されるため、この予備の送受信系に更なる障害が発生した場合、回線障害を引き起こす可能性があるが、波長多重通信システムの光出力回路は使用する波長が特定されているため、各波長のパッケージを保守用に持たせておかなければならず、このために障害が発生した光出力回路を直ぐに交換できない場合が生じる等の問題点があった。

【０００７】本発明はかかる問題点を解決するためになされたものであり、予備の送受信系を必要とせず、光出力回路に障害が発生した場合、伝送装置自身で光出力回路を切り換えて通信の続行が行える波長多重通信システム及びその障害救済方法を提供することを目的としている。

【０００８】

【課題を解決するための手段】本発明に係わる波長多重通信システムの障害救済方法は、伝送装置間で複数の信号をそれぞれ波長の異なる光信号に変換して合波し波長多重光通信を行う波長多重通信システムの障害救済方法において、各伝送装置に、通信に用いる波長以外の予備波長を送受信する機能を持たせておき、受信側伝送装置で何れかの光信号の受信に障害が検出される場合、この情報を送信側伝送装置へ送信し、送信側伝送装置では障害が発生した信号を前記予備波長の光信号に変換して送信することを特徴とする。

【０００９】また各伝送装置に、通信に用いる波長以外の複数の予備波長を送受信する機能を持たせておき、受信側伝送装置で何れか複数の光信号の受信に障害が検出される場合、この情報を送信側伝送装置へ送信し、送信側伝送装置では障害が発生した複数の信号を前記複数の予備波長の光信号にそれぞれ変換して送信することを特徴とする。

【００１０】さらに各伝送装置に、複数の信号をそれぞれ波長の異なる光信号に変換して合波し伝送路へ波長多重光信号を送信する光送信部と、伝送路から受信された波長多重光信号を分波する光受信部と、前記光送信部及び光受信部と同じ予備の光送信部及び予備の光受信部とが設けられ、各伝送装置間で前記光送信部と前記光受信部とが伝送路で接続され、前記予備の光送信部と前記予備の光受信部とが予備の伝送路で接続された波長多重通信システムの障害救済方法において、前記光送信部に通信に用いる波長以外の複数の予備波長を送受信する機能と、前記光受信部に前記複数の予備波長を受信する機能とを持たせておき、受信側伝送装置の光受信部で何れか複数の光信号の受信に障害が検出される場合、この情報を送信側伝送装置の光送信部へ送信し、該光送信部では障害が発生した信号を前記複数の予備波長の光信号に変換して送信することを特徴とする。

【００１１】また本発明に係わる波長多重通信システムは、伝送装置間で波長多重光通信を行う波長多重通信システムにおいて、各伝送装置に、複数の信号をそれぞれ波長の異なる光信号に変換して合波し伝送路へ波長多重光信号を送信する光送信部と、前記複数の信号の何れかを前記光信号に変換する波長以外の予備波長に変換し前記波長多重光信号に合波する予備波長送信部と、伝送路から受信された波長多重光信号を分波し出力する光受信部と、分波された各光信号を監視して障害が発生した光信号を検出する監視回路と、何れかの光信号に障害が発生したことを検出した場合、該光信号の出力として前記予備波長の光信号を選択すると共に、障害が発生した光信号の情報を送信側伝送装置に送信する制御手段と、受信側伝送装置から送信された前記情報により、前記予備波長送信部を動作させて該当する信号を前記予備波長に変換させる切換手段とを備えたことを特徴とする。

【００１２】また各伝送装置に、複数の信号をそれぞれ波長の異なる光信号に変換して合波し伝送路へ波長多重

光信号を送信する光送信部と、前記複数の信号の何れか複数をそれぞれ前記光信号に変換する波長以外の複数の予備波長に変換し前記波長多重光信号に合波する予備波長送信部と、伝送路から受信された波長多重光信号を分波し出力する光受信部と、分波された各光信号を監視して障害が発生した光信号を検出する監視回路と、何れか複数の光信号に障害が発生したことを検出した場合、該複数の光信号の出力としてそれぞれ前記予備波長の光信号を選択すると共に、障害が発生した光信号の情報を送信側伝送装置に送信する制御手段と、受信側伝送装置から送信された前記情報により、前記予備波長送信部を動作させて該当する複数の信号をそれぞれ前記複数の予備波長に変換させる切換手段とを備えたことを特徴とする。

【００１３】更に各伝送装置にさらに、前記光送信部と同じ予備の光送信部と、前記光受信部と同じ予備の光受信部とを有すると共に、前記予備の光送信部と前記予備の光受信部とが予備の伝送路で接続された、予備の送受信系をさらに備えたことを特徴とする。

【００１４】本発明の波長多重通信システム及びその障害救済方法は、上述のような構成とすることにより、光出力回路の障害に対し、システム自身が予備波長に切り換えて通信を継続するので、予備の送受信系を備えておく必要がなくなる。

【００１５】

【発明の実施の形態】以下、本発明の実施の形態について図面を参照して説明する。図１は、本発明の一実施形態を示すブロック図であり、図１において、１００及び２００はそれぞれ伝送装置、８ａ及び８ｂはそれぞれ伝送路である。また各伝送装置において、２はそれぞれ入力される電気信号をそれぞれ予め定められた波長（λ１～λ４）の光信号に変換する光出力回路、３は各光出力回路２からの光信号を合波して１本の波長多重光信号とする合波器、４は多重化された光信号を増幅する送信側増幅器、５は伝送路を介して送られてきた光信号を増幅する受信側光増幅器、６は光信号を分波する分波器、７はそれぞれ通過周波数帯域の異なるバンドパスフィルタ（ＢＰＦ）であり、これらは図２の同一符号と同一又は相当する部分であり、図２と同様、これらでそれぞれ光送信部１０１ａ，２０１ｂ、光受信部１０１ｂ，２０１ａが形成されている。

【００１６】また、１０は各波長の光信号の状態（すなわち正常な光信号が送信されているか否か）を監視する監視回路、２０は予備波長λ５を抽出するためのバンドパスフィルタ（ＢＰＦ）、３０はＢＰＦ２０からの光出力を送信信号数に光分岐するためのカプラ、４０はＢＰＦ７からの光信号またはカプラ３０からの光信号を切り換えて出力するための選択回路である。また５０は制御回路で、監視回路１０で何れかの光波長信号に異常が検出された場合、異常が検出された波長に対する選択回路４０を動作させてカプラ３０からの光信号を選択させると共に、どの光波長信号に異常が発生しているかを送信側に知らせる制御情報を出力する。

【００１７】６０は制御回路５０からの制御情報を光信号に変換するための電気／光変換部、６１はこの光信号を通信に用いる波長多重光信号に合波するための合波器、６２は送信側から送られてきた波長多重光信号から制御情報を示す光信号を抽出するための分波器、６３は分波器６２の光信号を電気信号に変換し制御情報を出力するための光／電気変換部である。また７０は外部から入力される電気信号を分岐するためのカプラ、８０は受信側制御回路５０からの制御情報に従って入力される複数の電気信号のうちの１本を選択する選択回路、９０は選択回路８０で選択された電気信号を正常な通信で使用している波長λ１，λ２，λ３，λ４以外の予備波長λ５に変換するための光出力回路である。

【００１８】なお本明細書では、光出力回路を予備波長送信部とも言い、またカプラ３０，選択回路４０，制御回路５０，電気／光変換部６０，合波器６１で本明細書で言う制御手段が構成され、さらに分波器６２，光／電気変換部６３，カプラ７０，選択回路８０で本明細書で言う切換手段が構成されている。

【００１９】次に図１に示す実施形態の動作について説明する。例えば伝送装置２００の受信側では、受信される波長多重光信号を分波器６及びＢＰＦ７により各光信号に分け、各光信号を選択回路４０と監視回路１０とに出力し、監視回路１０が各光信号を監視する。制御回路５０は監視回路１０の監視結果を収集しており、監視回路１０で何れかの光信号に異常が検出された場合、どの光波長信号に異常が発生したかをそして監視回路１０で何れかの光信号に異常が検出された場合、どの光波長信号に異常が発生しているかを送信側に知らせる制御情報を生成し、この制御情報を電気／光変換部６０へ送り、光信号に変換して合波器６１で通信に用いる波長多重光信号に合波する。そして制御情報が合波された波長多重光信号は、伝送路８ｂを介して伝送装置１００の光受信部へ送信される。

【００２０】伝送装置１００では、伝送路８ｂを介して入力される波長多重光信号から分波器６２で制御情報が乗っている光信号を抽出し、光／電気変換部６３で電気信号に変換して選択回路８０へ入力する。上述のように選択回路８０にはカプラ７０で分岐された外部からの各送信信号が入力されており、選択回路８０は送られてきた制御情報に従って受信異常が発生している送信信号を予備の光出力回路９０へ入力し、この送信信号を予備波長λ５の光信号に変換し、合波器３で送信する波長多重光信号に合波し、伝送路８ａを介して伝送装置２００へ送信する。

【００２１】伝送装置２００へ送信された波長多重光信号は、分波器６及び各ＢＰＦによって各光信号に分離さ

れるが、ＢＰＦ２０は波長λ５の光信号を出力するように設定されており、出力された波長λ５の光信号はカプラ３０を介して選択回路４０へ入力される。制御回路５０は監視回路１０からの監視情報により、異常が検出された光信号の選択回路４０の入力を、カプラ３０からの入力に切り換えており、これにより異常が検出された光信号は予備波長λ５で通信され、波長多重光信号の通信を続行できるようになる。

【００２２】なお図１に示す実施形態では、信号に利用される波長をλ１～λ４とし、予備波長をλ５として説明しているが、信号に利用される波長が４波に限定される訳ではなく、また予備波長を複数波長持たせた構成としても良い。また図１に示す実施形態では、光出力回路２の障害に対応させることができるが、伝送路の障害に対しては対応することができない。従って更に図３に示すような予備の光送信部，予備の光受信部，予備の伝送路からなる予備の送受信系を持たせた構成とすることもできる。

【００２３】

【発明の効果】以上説明したように本発明の波長多重通信システム及びその障害救済方法は、何れの波長で障害が発生しても波長多重装置側で自動的に予備波長に切り換えて通信を継続でき、障害波長のパッケージが交換されるまでの間、エンドユーザに影響を与えずに障害の復旧が可能となる。また予備波長で通信を継続できるため伝送装置に必ずしも全波長の光出力回路を予備させておく必要がなくなる等の効果がある。

【図面の簡単な説明】

【図１】本発明の一実施形態を示すブロック図である。

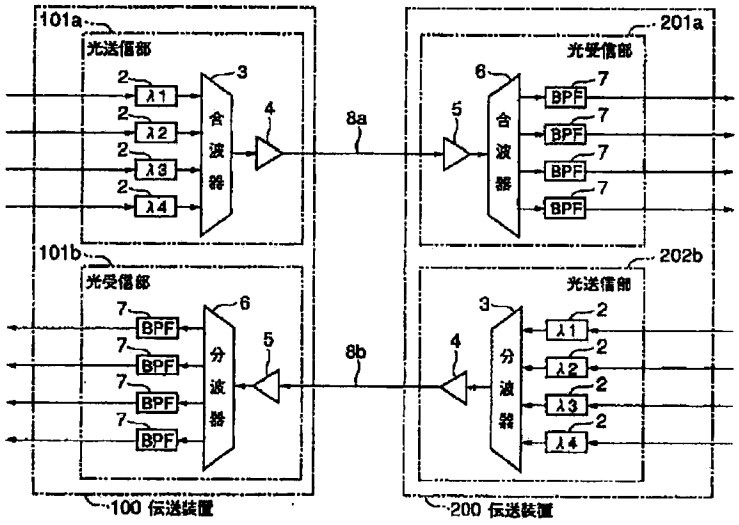
【図２】従来のこの種の波長多重通信システムの一例を示すブロック図である。

【図３】従来のこの種の波長多重通信システムの他の一例を示すブロック図である。

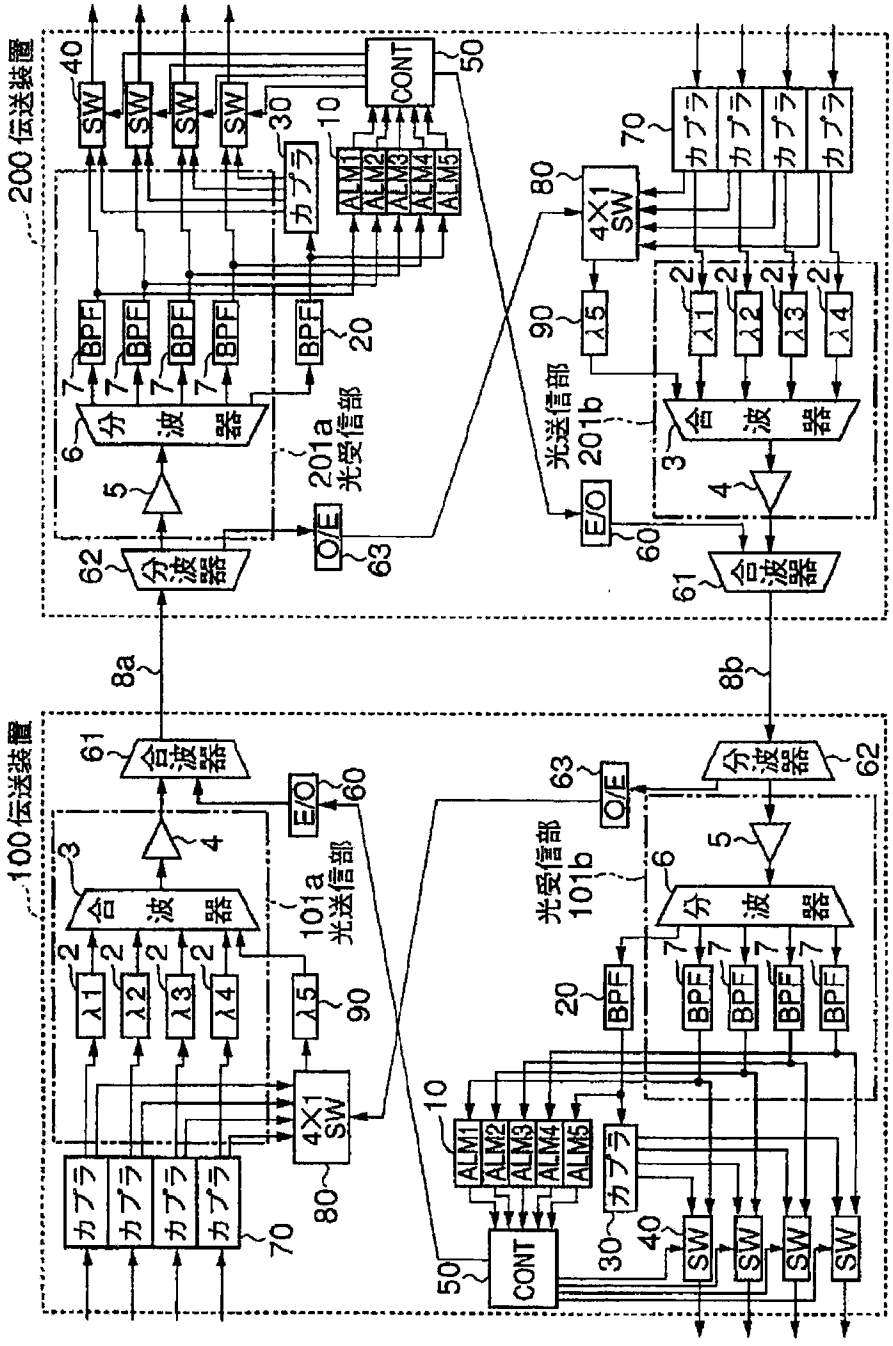
【符号の説明】

２　光出力回路
３　合波器
４　送信側増幅器
５　受信側光増幅器
６　分波器
７，２０　バンドパスフィルタ（ＢＰＦ）
８ａ及び８ｂ　それぞれ伝送路
１０　監視回路
３０　カプラ
４０　選択回路
５０　制御回路
６０　電気／光変換部
６１　合波器
６２　分波器
６３　光／電気変換部
７０　カプラ
８０　選択回路
９０　光出力回路
１００及び２００　それぞれ伝送装置
１０１ａ，２０１ｂ　光送信部
１０１ｂ，２０１ａ　光受信部

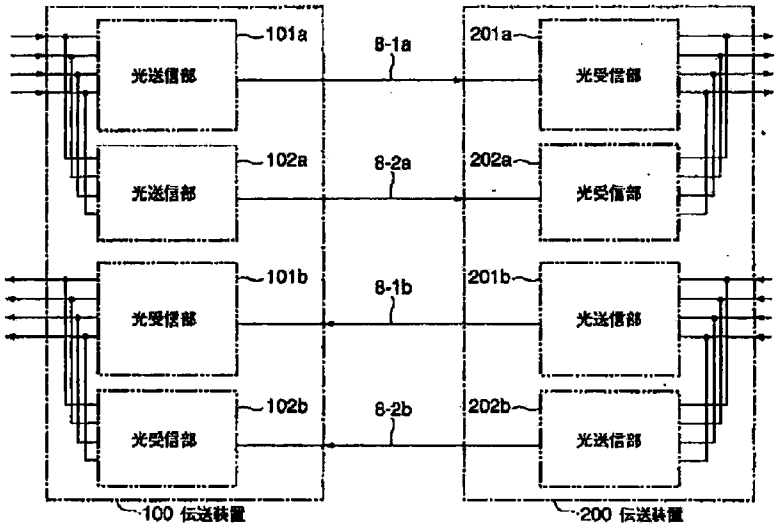
【図２】



【図1】


200 伝送装置
100 伝送装置
SW
CONT
カプラ
ALM1
ALM2
ALM3
ALM4
ALM5
BPF
分波器
合波器
光受信部
光送信部
E/O
O/E
4×1 SW
λ1
λ2
λ3
λ4
λ5
8a
8b

【図３】


101a
光送信部
102a
光送信部
101b
光受信部
102b
光受信部
100 伝送装置
8-1a
8-2a
8-1b
8-2b
201a
光受信部
202a
光受信部
201b
光送信部
202b
光送信部
200 伝送装置